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ABSTRACT

This paper discusses the utility of a general systems theory paradigm for psychology. The paradigm can be used for conceptualizing such complex phenomena as change over time in living systems, person-society interactions, and the epistemology of multiply determined changes. Consideration is also given to applications of the approach to developmental research on aging and Piagetian postformal operations. The discussion indicates characteristics and core themes of general systems theory, as well as some system functions that are present in all systems. Tables supplementing and summarizing the discussion delineate (1) "patterns of systematic system change over time," (2) system characteristics that permit and retard change, and (3) what systems theory teaches about personal change. Other materials cover the systems involved in relativistic thought, and the balance between potential and order in a living system. (RH)

Changing the Known; Knowing the Changing: General Systems Theory Paradigms as Ways to Study Complex Change and Complex Thoughts

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RUNNINGHEAD: CHANGE

Changing the Known; Knowing the Change:

General Systems Theory Paradigms as Ways to Study

Complex Change and Complex Thoughts

The problem of change, its forms, and knowledge of it is currently of interest in psychology. Questions may be articulated in the context of personal change, person-society interrelations, cognitive development, development over the lifespan, or of change in relationships. At this point in the history of psychology we are ready to try to understand not only static entities but <u>changing</u> realities, much as physics has moved from the understandings of a Newtonian world to the understanding of "new physics" realities.

The general systems theory approach (GST) is useful in conceptualizing change over time in living systems, person-society interactions, and the epistemology of multiply determined changes. Such issues as awareness and intentionality in living systems, Piagetian postformal operations, cognitive filters, constructionism, co-constructed social realities, interfaces between "living" social systems and "living" human systems, dialectical thought, self-referential truth, and "new age" co cepts can all be addressed in a general systems theory model.

This paradigm and its applications will be discussed in this paper. Such applications will include clinical applications, postformal thought and other cognitive research applications, social cognition, interpersonal relations research, and especially applications to midlife and aging

developmental research, illustrated with this author's own work. The utility of a general system theory paradigm for psychology will be discussed.

<u>What is GST?</u>

GST is an <u>amusing</u> theory. Wigner, in a lecture, once said that theories can be "interesting" or "amusing". An interesting theory may have merit but is often quickly forgotten; an amusing theory is one that makes you <u>think</u>. GST is an amusing theory.

GST, as I'll use the term here, is an attempt to unify science by finding structures and processes common to many entities. Of greatest interest are entities that are complex organizations, with boundries, having some continuity over time, and able to change in orderly ways over time. Such entities may be called living systems (Miller, 1978) whether they are cells or societies. GST had for its earlier theorists such luminaries as Norbert Weiner (1961) and Ludwig von Bertalanfy (1968). Today it is expressed in the language of quantum physics, chemistry, the family systems approach in clinical psychology, von Neumann's (von Neumann & Morgenstern, 1947) game theory, biofeedback, sociology (LockLand, 1973), ecological perspectives in psychology (Bronfenbrenner, 1979) and many others. The growth of interest in systems views is partly due to the growth of knowledge which prods us to go beyond single variable studies since we see many more complex components in the expression of any relationship. We also have new ways to analyze such complex system data, for example, multivariate analysis, and when tools exist, uses are created. Of course that statement itself is a systems theory interpretation of these events over time.

What are some core themes of GST? The first is the concept of a <u>system</u>,

that is, a network of related components and processes which work as a whole. Linkage and interaction are key themes, since whatever influences one part or process influences all of the parts and processes (i.e., the entire system). Systems coordinate their activity by means of feedback either from within or from without. Feedback from within leads to homeostasis or equilibrium within; feedback from without leads to balance between two systems. Equilibrium is a balance between or among system parts. Given a state of disequilibrium there will be an energy flow from one part to another. Any number of systems can have common mechanisms - isomorphic processes - for doing some task. For example, getting energy from one point to another may occur by means of chemical transmission, glucose metabolism, or moving commuters via subways. Since systems do interact and trade things like energy, GST recognizes that scientists need to make conscious decisions to determine system limits or parameters and levels of description. We have not always done this in the past. Thus there is an awareness of the observers' input on the "reality" observed. For example, if I draw my boundaries of the system at the person level, I may correctly say that an elder's depression is caused by poor coping strategies; if I draw boundaries at the societal level, I may say with equal correctness that the depression is caused by social stigmas attached to aging. I would be correct in both cases and would investigate different things. Systems theory examines multiple causal variables, or at least considers that they may be present, and focuses most on the processes used to go from one state to another. This makes GST a "natural" for developmental psychologists (like the author) who are interested in processes behind changes over time as

much as in the states of persons at various time points.

What are some system functions that are commonly present in all systems? First, a "living" (in the broad sense used previously) system operates so as to maintain some continuity over time, some structured wholeness, even while continuing, if appropriate, to grow. Second, systems function to transfer and contain energy and information from one point to another, within or between them. All systems have some means of boundry creation and maintenance, as well as means of interaction with other systems. This means that the boundry must be permeable to some extent, but not so permeable that the system merges with other systems. Other systems functions control other processes, run circular processes, and give feedback. The overall goal is to provide optimum input for continuity and growth while avoiding pathology and maintaining flexibility.

Change. Systems do change over time. How does this happen? The only way systems can change over time is if some entropy or disorder is present. If this is not readily obvious, consider for a moment what would happen if no disorder were present and all elements were structured into some form; there would be no "space" and no raw "material" to use to make new forms. If a child has used all available blocks and space to make a "city" (all ordered) some disorder must be introduced (push the blocks aside) for the next orderly structure (perhaps a tower) to be built. If my "mind is made up" on an issue, I must introduce doubt before change of mind is possible. So, disorder - entropy - is not only the catastrophic final state predicted by the Second Law of Thermodynamics, but also the beneficial means to flexible re-ordering, or growth to a larger order. Figure 1 illustrates this further.

Insert Figure 1 about here

When systems change over time they usually move from complete disorder, through increasing order and bounding (a state that may last most of the system's life time) to overrigidity. The overly ordered, overly structured rigid state admits no change and is shattered by any input from outside. An analogy is what happens to a rigid crystal goblet which breaks under high frequency vibrations, while the even thinner skin on the hand holding it does not. Prigogene (1980) notes that it is always possible to create a better structure from shattering a rigid state. From that shattering and availability comes some more flexible more complex form. This means the death of the old system, or its re-emergence in very altered form.

Imagine a situation where two systems - societies for example - come up against each other and try to influence each other (i.e., intrude on each other's boundaries). If the first system is not too rigid and too ordered the influence and energy of the second will have an impact and alter the first. The reciprocal will also be true. But if the first system is rigid, the second will not be able to influence it. Now, if the energy of the second becomes stronger still, and it cannot influence the first subtley, violent influence might result in a complete shattering of the first. Instead of gradual change occurring, complete change occurs. Defenses sometimes, then, become problems in their own right and destroy rather than protect. The gentler dynamic - mutual influence of semi-ordered systems - occurs during political dialogues.

The second more catastrophic dynamic - destruction of an old overordered system - occurs during revolutions. Some other examples of the dynamics of change over time in a number of very different systems are in Tables 1, 2, and 3.

Table 1 describes, in column 1, six steps that typically occur over time in any "living" system in column 1. Examples of their presence are given for physical systems (column 2), couple or dyad systems (column 3), and cognitive systems (column 4) to show how common and widespread is evidence for such dynamics over time. Table 2 outlines the characteristics of systems which influence whether the potential changes over time in Table 1 can actually come about in any one case. Table 3 relates those characteristics to the challenge of personal change, suggesting that change is a necessary, challenging, natural opportunity which need not be harmful or overly stressful. Intentional personal change, such as psychotherapy, simply uses these processes efficiently. Figure 2 shows the multiplicity of systems involved with relativistic Piagetian postformal thought.

Insert Tables 1, 2, and 3 and Figure 2 about here

System change over time demands more than some degree of entropy. Systems resist disorder on any large scale, and change means the temporary elimination of much order. The resistence to this in the psychological system is evident in the sometimes painful reorganizations during personal change, for example, in psychotherapy. Any system tries to monitor and control the extent of disorder, but not resist entirely since that takes so much energy. Surviving

systems balance potentials and actualizations, have boundries but are not closed, try to flexibly fit many contexts, and attempt to interface with other systems without being engulfed or engulfing. Non-surviving systems may have the same structures (eg. a boundry) but have different processes (eg. rigidity in boundry) that are less adaptive.

GST: "Next generation" developmental research?

Systems theory provides a way for us to make sense of a new generation of developmental research. We researchers are responding to more "information" which we allowed to enter our system and disturb it. We have seen that the respondent and the experimenter are not independent of each other but influence each other at all times. We've seen that development depends upon the perceptions of the developing person. We've seen that change over time involves compensatory mechanisms that help maintain homeostasis for the person. How do we deal with this complexity? A world view with causality as linearly dependent on single variables does not do it justice. Simply adopting a multivariate perspective is not adequate either, because such a view often leaves us casting about in the choice of variables to explore. Adoption of a GST view gives us more options as to ways to talk about process and structure, suggesting variables, dynamics, and even levels of study that would be relevant. GST lets us reorder our perturbed system on a more complex level, rather than making our boundries more rigid in order to ward off the new information.

GST gives developmental studies access to a relativistic, contextual world view in which subject and object are necessarily related, but in which

the scientific method can still be employed and must be. GST is the language of the so-called "new physics", i.e., relativity theory and quantum mechanics, etc. In an earlier paper (Sinnott, 1981) I discussed a relativistic model for development. GST is one language that model might use.

Some research issues and applications

My own research (see, for example, Sinnott, 1984, 1986, 1987a & b) has applied the GST paradigm to the study of change over time in several areas, most notably aging, lifespan cognitive development, development of everyday memory in adulthood, and cognition-physiology relations for adults. Some of these ideas will be addressed below.

Applications to aging. It's important first to mention that, for this author, "aging" is defined not so much by years as by degree of rigid structuredness or terminal entropic deterioration. To some degree, of course, age and structuredness correlate. But for the moment let's remember that a system is old when it is rigid and has strong boundries that permit little information flow. Our aging studies will generally include chronologically old persons, some of whom have old systems and some of whom do not.

Aging, then, means slower, more idiosyncratic performance. GST ideas serve aging studies when we address how degree of stimulation is regulated in such a system. A system has an optimum amount of stimulation (or information, energy) it can process; old systems process less. What information is selected for processing? How? What survival effects result? Can lack of stimulation be modified by modifying boundries? Explanations for slowing of memory and possibilities for intervention are richer if one thinks in GST terms.

Older persons often perform adequately, although they are seriously lacking in some process. Perhaps they compensate somehow, we say. Using a GST view, we assume that all systems compensate and have regulatory processes to decide when to compensate. They compensate for internal disequilibria and for disequilibria resulting from encounters with other systems. Older systems need to compensate for rigid boundries and over-orderedness (and therefore for too little information entering and leaving storage); younger systems need to compensate for too little structuredness and too-porous boundries (and therefore for too few pegs on which to store data, and for too little data overall). The overall system state is the only thing that can predict the kinds of cognitive compensation needed or the outcome of various compensations. GST would consider how those behaviors serve the system and result from storage problems.

Rigid, cautious performance is characteristic of the declining old and influences families and society. The overstructured system has little storage available. Another system encounters it, tries to share information, and is rebuffed in self defense, unheard, making no impact on thicker and thicker boundries. Perhaps the second system then tries harder to share information. This induces perturbations in the first. If these become strong enough, the structure of the first system might fly apart, destroyed, (this is a sort of terminal disorder) or may be ordered at a new, more adaptive, level. This is the leap to a new order described by Prigogene (1980; Prigogene & Stengers, 1984). At this point the individual system would either have ended or become more adaptive. One cycle of effects and feedback from an individual to other

levels of family and society. Any action influences the entire order of nested systems. So any single cognitive component such as memory can be viewed as an information processing component which helps keep order in everchanging multiperson space of the older person.

Piagetian Postformal operations. For several years I have been researching the positive cognitive development of adults. I describe some of the characteristics of that development as "relativistic" postformal thought. The main unique characteristics of such thought are that 1) it organizes lower stages, such as formal operations, and 2) it includes self-referential thinking and necessary subjectivity, that is, awareness that there is no one single view of the truth. The self-referential thinker exists in a world where his or her view or filter of things partly changes their very (perceived) nature. The clearest example of this process is in social cognition, where two knowers create--moment by moment--the nature of their interaction.

Postformal thought is the stage of Piagetian cognitive development where one is OF NECESSITY focused on process and interaction as truth, and focused on the interplay of multiple knowing systems, each with a "mind of its own." This interplay can go on during family interactions, during clinical experiences, between friends, or between the societal system and the individual system. "Knowing," in postformal operations is an exercise in the study of ill-structured problems and their solutions. Since the known is co-created by awareness of the knower and the qualities of the known, the consciousness of the knower and the filters of the knower and the intentions of the knower and the emotions of the knower are important to the cognitive experience. The

knowing system includes them all. And just as two persons co-create their knowledge of each other, an individual system and a social system cocreate their knowledge of each other, act on that knowledge basis, and thereby co-create each other. Cognitively speaking, in a paradoxical way, the sometimes simplistic sounding ideas of the "power of positive thinking" and "creative intention" may have been on the right track. The GST view of problem solving may give us ways to address these questions.

Note to discussant:

Jack-- As time permits I will then describe my research, which is familiar to you.

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TABLE 1

PATTERNS OF SYSTEMATIC SYSTEM CHANGE OVER TIME

ING SYSTEM	PHYSICAL SYSTEM	COUPLE SYSTEM	COGNITIVE SYS
iosis, fferentiated	High entropy, low order	Honeymoon period, finding roles in the marriage	"Bottom up" d processing; focused atten small data ba
erentiation	Increasing boundry creation; increasing structure and efficiency	Power struggle	Concrete opera tions and conc development
rary stasis		Stability	Abstract thoug formal or scie reasoning; "to processing now combined with "bottom up" pr spotlight and light attentio
c tasis	Balanced, flexible; half ordered, with moderate boundries to permit assimilation of new information	Commitment to the paradox of the other	Selective creat of chosen reali and belief syst
uction/ sis		Co-creation of the relationship and the world	Wisdom; awaren of #4 above; problems usual seen as ill structured
death	Rigid boundries, no information flow; any one perturbation can lead to disaster and final entropy	------	Idiosyncratic "top down" impos tion of abstract constructs

TABLE 2

SYSTEM CHARACTERISTICS
THAT PERMIT CHANGE AND RETARD CHANGE

1. The system must permit more information to enter...flexibility, but under bounded control.
2. Systems resist disorder.
3. Change means temporary increase in disorder.
4. Systems monitor and control the amount of disorder.
5. Surviving systems contain the seeds of their own change, are "Programmed" to get to the next highest level of order (eg, puberty is inherent in infant).
6. Surviving systems balance potentials and activated processes.
7. Surviving systems fit many contexts.
8. Surviving systems are programmed to interfere with each other.
9. NONsurviving systems have the same parts as surviving systems, but different PROCESSES.

TABLE 3

WHAT SYSTEMS THEORY TEACHES ABOUT PERSONAL CHANGE

1. All systems change, except those near death, so change is a <u>good</u> sign.
2. Patterns of change are predictable, based on the state of the system and the state of adjacant systems.
3. Change in any one system will influence other systems nearby. Whether this leads to useful or maladaptive changes in those other systems depends upon their states.
4. Boundry rigidity in the face of information or energy flow means death; being completely unbounded means dissolution of the system. Systems strive for continuity.
5. Emersion in a new group(ie, interaction with a new system that is powerful) is a sort of reparenting(transference and imaginal reparenting are other forms)that can efficiently and effectively and efficiently reorient a system.

FIGURE 1

A LIVING SYSTEM - POTENTIAL/ACTUALIZED BALANCE

1/2 potential, 1/2 order
entropy negentropy
moderately bounded

Increasing order
Over-ordered
Tightly bounded
Poor info flow
Poor accommodation to new forms

adult
aging
death
birth
child

disordered, but order increasing

lightly bounded

good info.flow

accommodates w/ few perturbations

All potential=all ordered
All entropy=total structure
Little info.in structure
AND 100% info.in structure

Which of these is true is determined by perspective of observer/system AND level of observation

GENESIS: Process of shared cognition of social experiences

PERSONAL LEVEL: Postformal relativistic thought

EVIDENT IN:

- -Solution of practical problems
- -Consciously altered states of consciousness
- -Advanced scientific thought
- -Interpersonal relations having flexability and empathy
- -Complex information processing

BIOLOGICAL SUBSTRATUM:

Epigenetic encoding of adaptive behavior

SOCIAL SUPERSTRATUM:

Groups and societies act and change in line with their shared cognitions

Figure 2. Systems Involved in Relativistic Thought